



THE FINAL REVIEW: THE REST OF THE MATERIAL

Aswath Damodaran

The final pieces of the puzzle

- Real Options
 - ▣ The three key questions
 - ▣ The option to delay: Patents & Natural resources
 - ▣ The options to expand & abandon
 - ▣ The value of financial flexibility
 - ▣ Equity in deeply troubled firms
- Acquisition valuation
 - ▣ Key principles on risk & discount rates
 - ▣ The value of synergy & control
 - ▣ Acquisition mechanics (Exchange offers)
- Value Enhancement
 - ▣ The drivers of value
 - ▣ Value enhancement
 - ▣ Voting & non-voting shares

Real Option: Key Questions

- Is there an option embedded in this asset/ decision?
 - ▣ Can you identify the underlying asset?
 - ▣ Can you specify the contingency under which you will get payoff?
- Is there exclusivity?
 - ▣ If yes, there is option value.
 - ▣ If no, there is none.
 - ▣ If in between, you have to scale value.
- Can you use an option pricing model to value the real option?
 - ▣ Is the underlying asset traded?
 - ▣ Can the option be bought and sold?
 - ▣ Is the cost of exercising the option known and clear?

Option Pricing Model: Reading the Entrails

In the Black Scholes model the value of a call and put are estimated by creating and valuing replicating portfolios. In the dividend yield adjusted versions:

$$C = S e^{-yt} N(d1) - K e^{-rt} N(d2)$$

where,

$$d_1 = \frac{\ln\left(\frac{S}{K}\right) + \left(r - y + \frac{\sigma^2}{2}\right) t}{\sigma \sqrt{t}} \quad \text{and } d_2 = d_1 - \sigma \sqrt{t}$$

- The value of a put can also be derived from the call

$$P = K e^{-rt} (1-N(d2)) - S e^{-yt} (1-N(d1))$$

- The model has embedded in it some key features:

- ▣ The dividend yield operates as a trigger pushing an investor to exercise early. More generically, you can think of it as the cost of delaying exercise, once an option becomes in the money.
- ▣ $N(d_2)$: Risk neutral probability that the option will end up in the money.
- ▣ $N(d_1)$: Also can be read as a probability and $N(d_1) - N(d_2)$ can very loosely be thought off as the range of probability that the option will be in the money.

The Cost of Delay

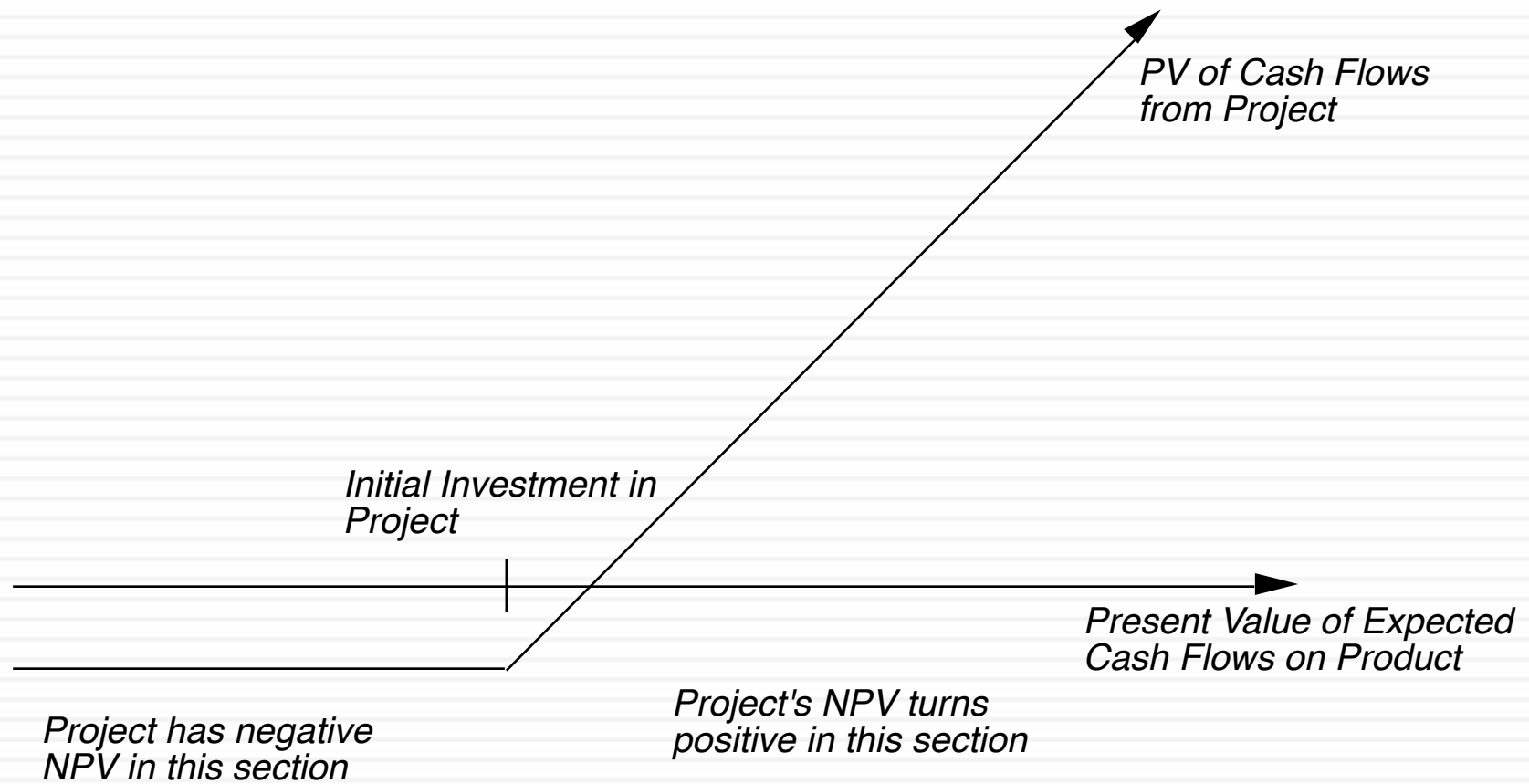
- The cost of delay is a measure of how much you will lose in the next period if you don't exercise the option now as a fraction of the current value of the underlying asset. There are three ways you can get it:

Option 1: If you have a decent estimate of the cashflows you will receive each period from exercising the option, it is better to use that cashflow/ PV of the asset as the dividend yield. (Example: Cash flows on an oil reserve)

Option 2: If your cashflows are uneven or if you do not know what the cashflow will be each period, you should use $1/n$ as your cost of delay. (Patent & life)

Option 3: If you will lose nothing in terms of cashflows by waiting, you should have no cost of delay. (Olympics example)

The Option to Delay a Project



I. Valuing a Patent

Input	Estimation Process
1. Value of the Underlying Asset	<ul style="list-style-type: none">• Present Value of Cash Inflows from taking project now• This will be noisy, but that adds value.
2. Variance in value of underlying asset	<ul style="list-style-type: none">• Variance in cash flows of similar assets or firms• Variance in present value from capital budgeting simulation.
3. Exercise Price on Option	<ul style="list-style-type: none">• Option is exercised when investment is made.• Cost of making investment on the project ; assumed to be constant in present value dollars.
4. Expiration of the Option	<ul style="list-style-type: none">• Life of the patent
5. Dividend Yield	<ul style="list-style-type: none">• Cost of delay• Each year of delay translates into one less year of value-creating cashflows $\text{Annual cost of delay} = \frac{1}{n}$

Example: Problem 5, Spring 2008

- You have been asked to value a new technology for producing and distributing solar power. You estimate that the technology will need an up-front investment of \$ 1.5 billion and that the expected cash flows will depend on the price of oil. For every dollar that the oil price exceeds \$ 100, the firm expects to generate \$ 20 million in annual after-tax cash flow, each year for 10 years. The expected cash flows are risky and the appropriate discount rate for these cash flows is 12%. The current oil price is \$ 110 and the standard deviation in \ln (oil prices) is 30%. The riskless rate is 4%.
 - a. Estimate the net present value of the solar power investment at the current oil price.
 - b. Now assume that you can get the exclusive rights to this technology for the next 15 years. Estimate how much you would be willing to pay for these exclusive rights?

Solution

After=tax cash flow = 200
PV over 10 years = 1130.044606
Investment = 1500
NPV = -369.9553943

Option inputs

S = 1130.044606
K = 1500
t = 15
Standard deviation = 30%
Riskless rate = 4%
Cost of delay = 0% if you assume that the project life will not be truncated
10% if you assume that the project life will be truncated if taken after yr 5

Value of the option

With no cost of delay	\$596 million	! Rounding off will yield about \$592 million
With 10% cost of delay	\$38 million	
With 17.7% cost of delay	\$2 million	

II. Valuing a Natural Resource Option

Input	Estimation Process
1. Value of Available Reserves of the Resource	<ul style="list-style-type: none"> Expert estimates (Geologists for oil.); The present value of the after-tax cash flows from the resource are then estimated.
2. Cost of Developing Reserve (Strike Price)	<ul style="list-style-type: none"> Past costs and the specifics of the investment
3. Time to Expiration	<ul style="list-style-type: none"> Relinquishment Period: if asset has to be relinquished at a point in time. Time to exhaust inventory - based upon inventory and capacity output.
4. Variance in value of underlying asset	<ul style="list-style-type: none"> based upon variability of the price of the resources and variability of available reserves.
5. Net Production Revenue (Dividend Yield)	<ul style="list-style-type: none"> Net production revenue every year as percent of market value.
6. Development Lag	<ul style="list-style-type: none"> Calculate present value of reserve based upon the lag.

Example: Problem 5, Spring 2011

- You are valuing an oil company with significant undeveloped reserves and have collected the following information on the company:
 - The company has developed reserves of 100 million barrels. It is extracting 10 million barrels a year, and the marginal (variable) cost per barrel of oil extracted is \$ 40/barrel. The price per barrel is \$75/barrel. The tax rate is 40% and the company's cost of capital is 9%. (You can assume that both oil prices and the cost per barrel are expected to stay at the same level for the foreseeable future.)
 - The company has undeveloped reserves of 150 million barrels, and has 20 years to explore and develop them. The initial cost of developing all these reserves is \$ 3 billion and the variable cost per barrel, once developed, will be 20% higher than it is for the current developed reserves.
 - The standard deviation in oil prices is 30% and the riskfree rate is 4%.
 - There is a one-year lag between the decision to develop the reserves and oil production commencing.
 - a. Value the developed reserves for the company.
 - b. Value the undeveloped reserves for the company, using option pricing.
 - c. Now assume that you had valued this company using a conventional discounted cash flow model, using a growth rate and the expected oil price to incorporate the undeveloped reserves. Would the value per share that you obtain by doing so be higher than, lower than or equal to the value using the option pricing approach?

Solution

a. Developed reserves

Pre-tax cash flow/barrel	35
Annual after-tax CF =	210
PV of CF for 10 years =	1347.708117

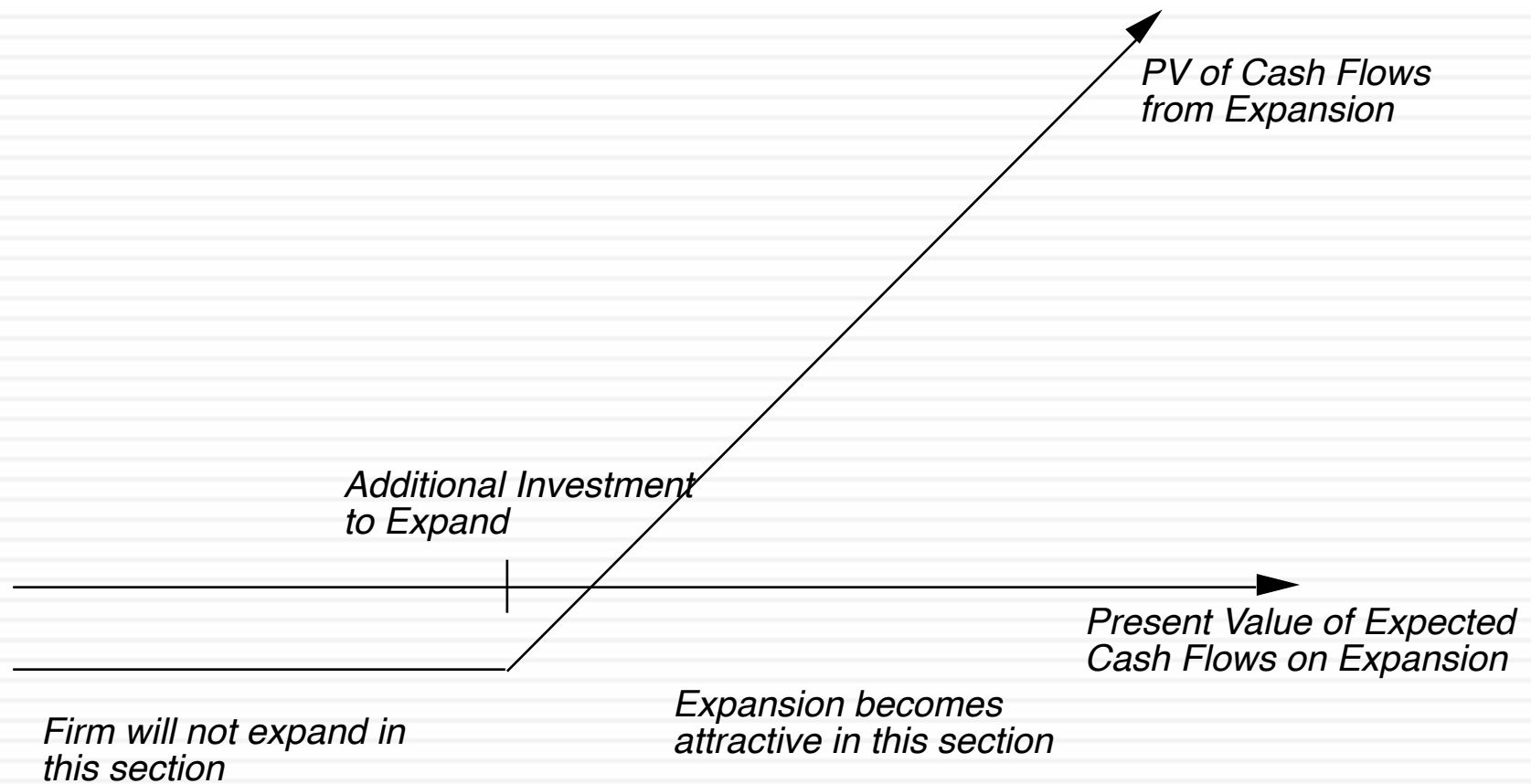
b. Undeveloped reserves

S =	1224.217055	! Annual cash flow = $10 \cdot 27 \cdot .6 = 162$; PV over 15 year
K =	3000	
r =	4%	
t =	20	
Standard deviation =	0.3	
Cost of delay =	0.066666667	! I am assuming that the extraction capacity is 10 million barrels. I also gave full credit if you assumed it to be 7.5 million barrels (5% cost of delY)

d1 =	-0.3949 N(d1)	0.3465
d2 =	-17365 N(d2)	0.0412
Value of undeveloped reserves =	\$56.20	

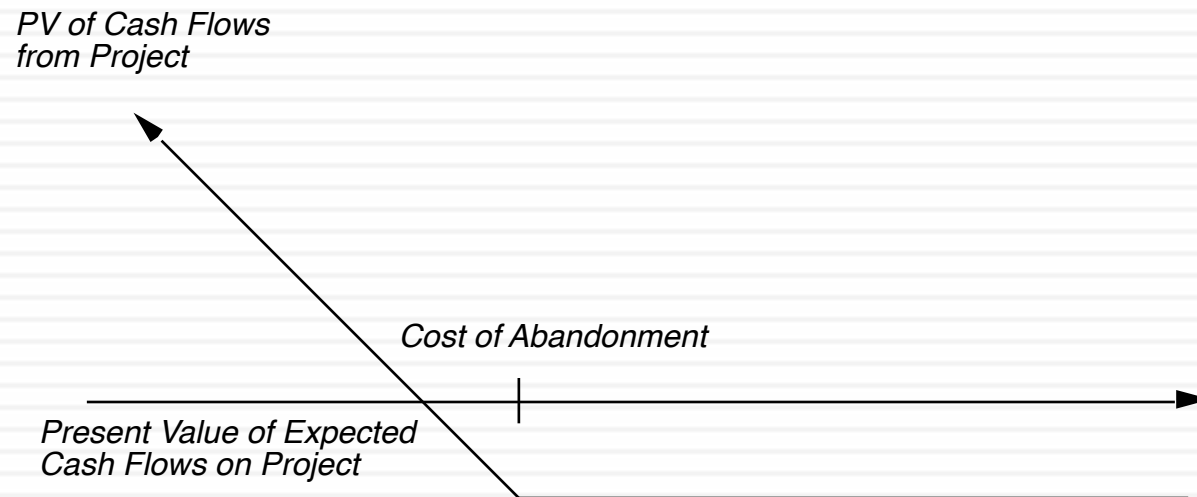
c. DCF value will be lower than the option value, for any given oil price expectation.

B. The Option to Expand

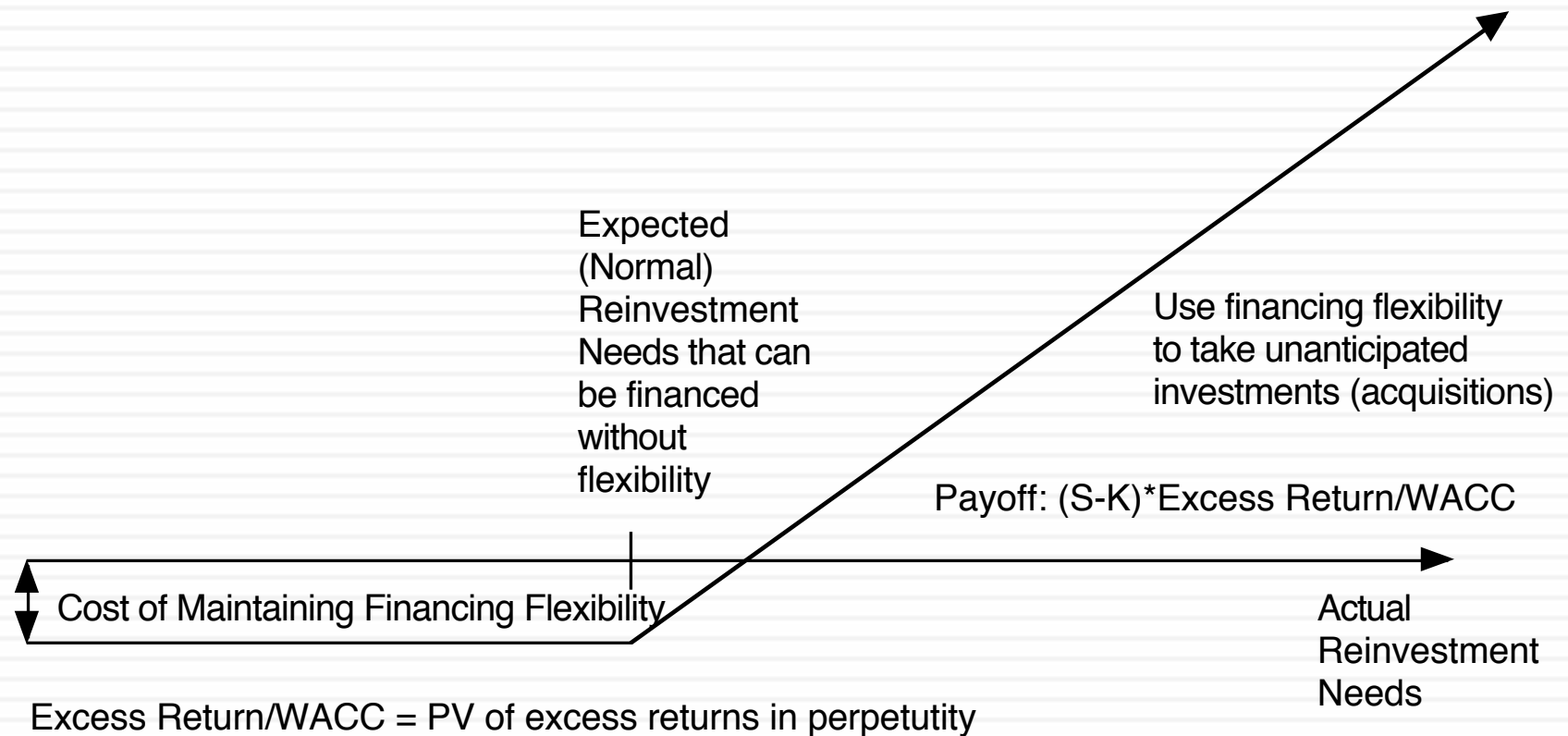


C. The Option to Abandon

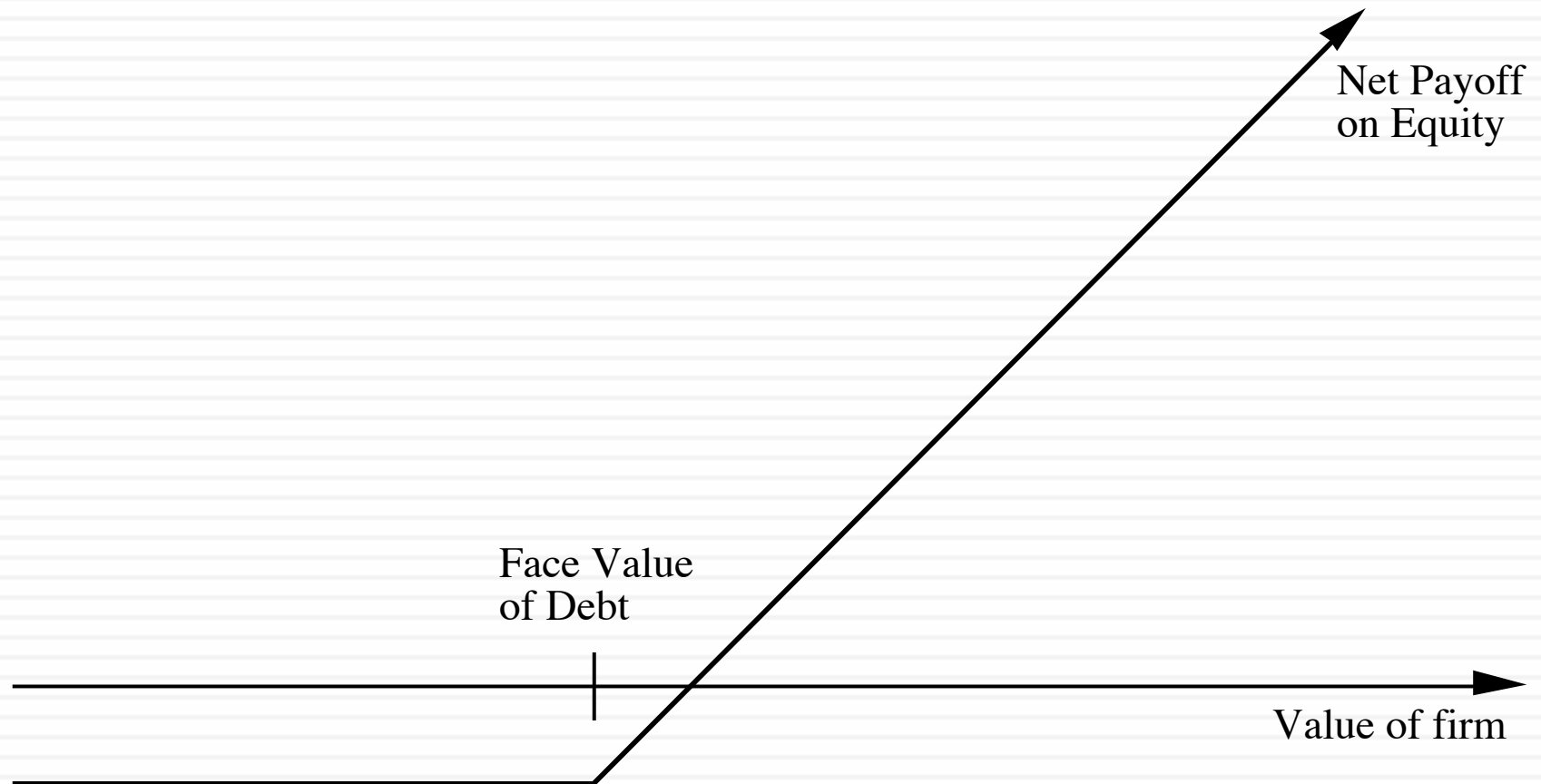
- A firm may sometimes have the option to abandon a project, if the cash flows do not measure up to expectations.
- If abandoning the project allows the firm to save itself from further losses, this option can make a project more valuable.



The Value of Flexibility



Payoff Diagram for Liquidation Option



Example: Problem 5, Spring 2010

- You are helping a vulture investor decide whether he should be investing in the equity of Reza Steel. You have collected the following information on the firm:
 - The firm is expected to report EBITDA of \$ 25 million this year and a net income of - \$10 million for the year.
 - Mature steel companies trade at an EV/EBITDA multiple of 6. The standard deviation in firm value at these companies is approximately 30% and the standard deviation in equity value is 40%.
 - Given the state of the market, you estimate that you will face an illiquidity discount of approximately 20% on the value of the assets liquidated.
 - The firm has substantial debt outstanding. The firm has two zero coupon bonds outstanding, \$ 120 million (face value) in five-year bonds and 80 million (face value) in ten-year bonds.
 - The treasury bill rate is 2% and the long term treasury bond rate is 4%.
- a. If you consider equity as an option (to liquidate), value the equity in the firm.
- b. Estimate the “fair” interest rate for the debt in the company.

Solution

S = Liquidation value =	120
K = Face value of debt =	200
t = Weighted duration =	7
r = Long term Tbond rate =	4%
Standard deviation in firm value =	30%
Value of equity as an option	
N(d1)	0.5422
N(d2)	0.2458
Value of the call =	27.91
Value of debt =	92.09
Interest rate on debt =	0.1172

Acquisition Valuation



- Cost of equity: The cost of equity for a target company should always be based upon the risk of the target company (its unlevered beta).
- Cost of debt & debt ratio: Should reflect what the target company can borrow at (either at its existing or target debt ratio)

The value of synergy

- Synergy accrues to the combined company and can take the following forms:
 - ▣ An increased capacity to carry debt, which manifests itself as a lower cost of capital
 - ▣ Cost cutting, which shows up as higher margins and operating income
 - ▣ More value from growth, which can be reflected in higher returns on capital, higher reinvestment rates or longer growth periods.
 - ▣ Savings in taxes
- The discount rate you apply to these cash flows should reflect the risk in these cash flows.

Example: Problem 3, Spring 2009

- 3. Simba Inc., an entertainment company, is considering an acquisition of Tiger Tales, a maker of animated movies. The information on the two companies is provided below (\$ values are in millions):

	Simba	Tiger Tales
EBIT (1-t) expected next year	\$100	\$ 80
Revenues	\$1000	\$1250
Book Capital invested	\$1000	\$1000
Expected growth	3%	3%
Cost of capital	9%	9%

- Estimate the value of the combined company, assuming no synergy in the merger. (2 points)
- Now assume that Simba Inc. believes that the combined company will be much stronger, relative to the competition, and will therefore be able to find more new investments in the next 4 years (doubling the reinvestment rate over that period for the combined firm) and earn a return on capital of 12% on new investments in perpetuity. (Existing investments at both firms will continue to generate their existing returns on capital) After year 4, the growth rate will drop back to 3% but the return on capital will stay at 12%. Estimate the value of synergy in this merger.

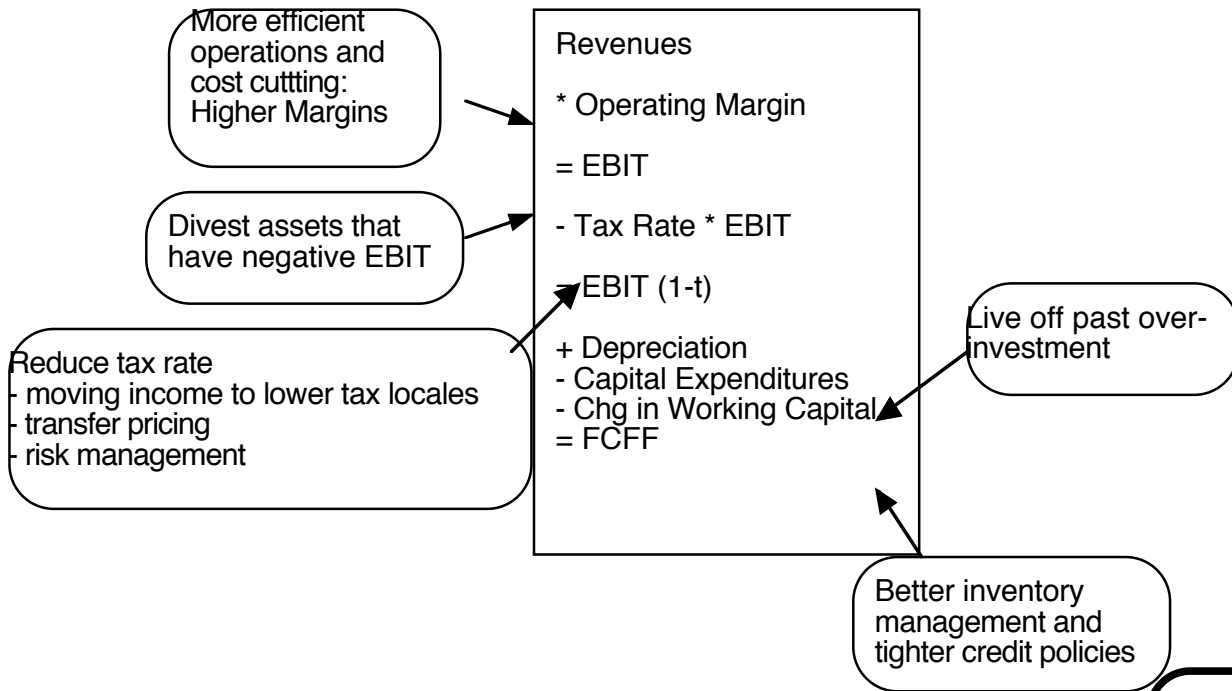
Solution

	Simba	Tiger Tales	Combined firm		
EBIT (1-t) expected next year	100	80			
Revenues	1000	1250			
Book Capital invested	1000	1000			
Expected growth	3%	3%			
Cost of capital	9%	9%			
Return on capital =	0.1	0.08			
Reinvestment Rate =	30%	38%			
Value today =	1166.666667	833.3333333	2000		
\$ Reinvestment	30	30	120		
Combined firm					
Reinvestment rate =	0.666666667				
Return on capital =	12%				
Expected growth rate =	0.08				
	1	2	3	4	Term year
EBIT (1-t)	\$180.00	\$194.40	\$209.95	\$226.75	\$233.55
- Reinvestment	\$120.00	\$129.60	\$139.97	\$151.17	\$58.39
FCFF	\$60.00	\$64.80	\$69.98	\$75.58	\$175.16
Terminal value				\$2,919.38	
Present value	\$55.05	\$54.54	\$54.04	\$2,121.71	
Value of firm today =	\$2,285.34				
Value with no synergy =	\$2,000.00				
Value of synergy =	\$285.34				

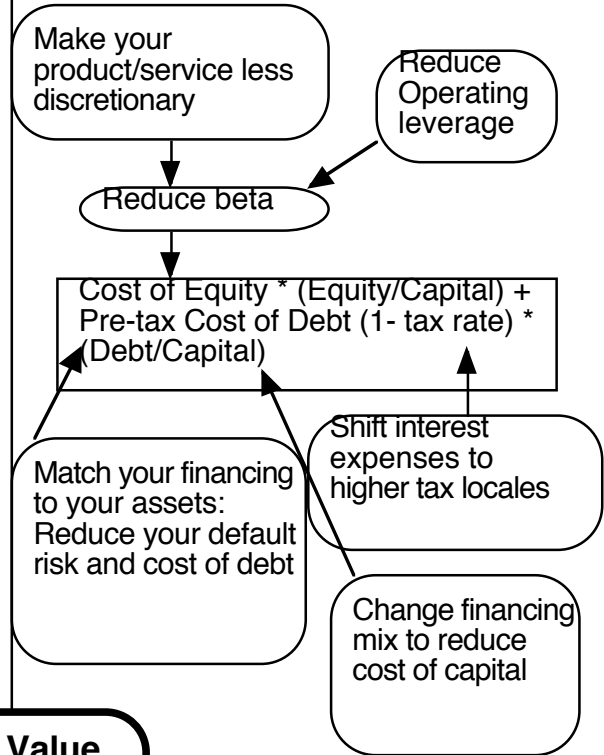
The value of control

- To value control in an acquisition, you have to value the company twice:
 - ▣ In the status quo valuation, you value the company based on its current management policy on investing, financing and dividends.
 - ▣ In the optimal valuation, you value the company based on the changes that you expect to make in these policies.
- The value of control is the difference between the optimal and status quo values, discounted back to the present (assuming that it will take you time to make the changes).

Increase Cash Flows

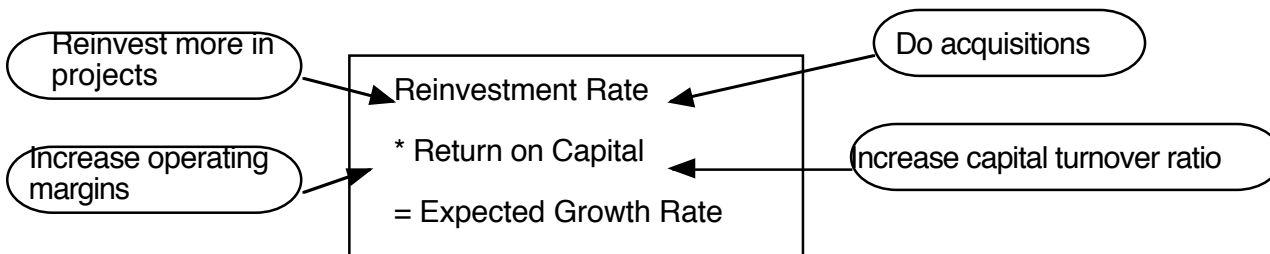


Reduce the cost of capital

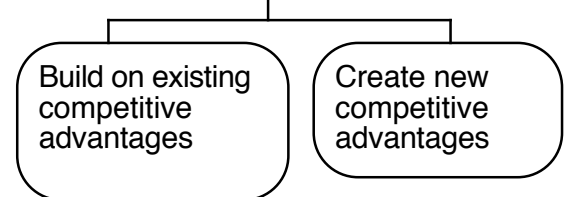


Firm Value

Increase Expected Growth

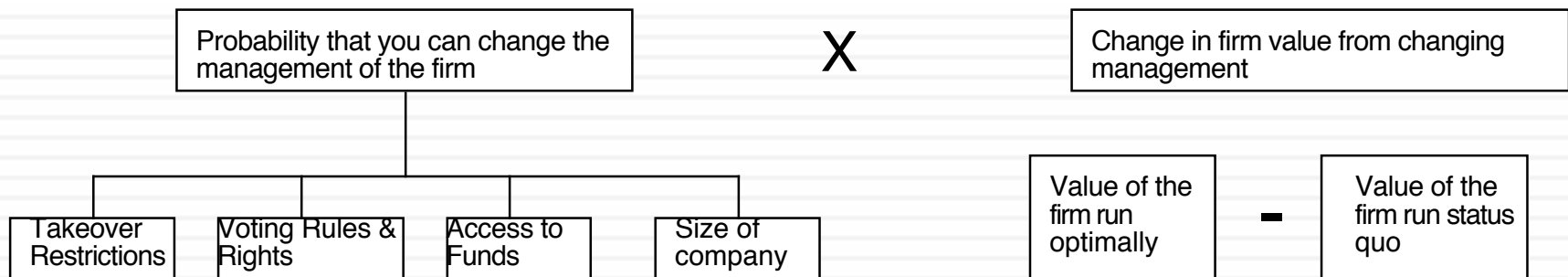


Increase length of growth period



The Expected Value of Control

The Value of Control



Example: Problem 3, Spring 2008

- Marley Steel is a publicly traded steel company with 20 million shares outstanding, trading at \$ 2 a share, and \$ 60 million in outstanding debt. The cost of capital for the firm was 12%. The firm is expected to generate \$ 16 million in after-tax operating income next year and is considered to be in stable growth, growing 4% a year in perpetuity.
 - a. Assuming that the firm is correctly valued by the market now, estimate the return on capital that the firm is expected to generate in perpetuity.
 - b. You believe that if you acquire control of the firm, you can sell idle assets (that are not generating operating income) for \$ 40 million and pay down debt. If you do so, your cost of capital will decrease to 10%. Estimate the new value for the firm if you can restructure it.
 - c. How would your answer to b change, if your plan is not to pay down the debt but to redeploy the assets to more productive investments, which will increase the after-tax operating income to \$ 25 million next year. The How expected growth rate will remain 4% a year in perpetuity and the cost of capital will continue to be 12%.

Solution

Problem 3

Firm Value = $100! 20*2 + 60$
 $100 = 16 (1 - .04/ROC) / (.12 - .04)$
Solving for ROC
Return on capital = 8%

b. Pay down debt option

If you assume that the write down of capital has no impact on future ROC
Reinvestment rate = 50.00%! $g/ ROC = 4/8$
New firm value = 133.3333333

If you assume that changes in the current ROC will also affect future ROC

Old capital = 200! $EBIT (1-t) / Old ROC$
New capital = 160! Sold off idle assets and reduced capital
New ROC = 10.00%! $16/160$
New Reinvestment rate = 40.00%! g/ ROC
Firm Value = 160

c. Redeploy capital

New EBIT (1-t) = 25
Capital = 200
New ROC = 0.125
New Reinvestment rate = 0.32
Firm Value = 212.5

Implications

- Publicly traded stock: The stock price of every publicly traded company should reflect the expected value of control in that company. Thus, anything that changes that expected value (changing corporate governance, activist investors) should change prices.

$$\text{Value per share} = \frac{\text{Status Quo Value} + \text{Probability of control change (Optimal - Status Quo Value)}}{\text{Number of shares outstanding}}$$

- Voting and non-voting shares:

$$\text{Value per non - voting share} = \frac{\text{Status Quo Value}}{\# \text{ Voting Shares} + \# \text{ Non - voting shares}}$$

$$\text{Value per voting share} = \text{Value of non - voting share} + \frac{\text{Probability of control change (Optimal - Status Quo Value)}}{\# \text{ Voting Shares}}$$